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STEAM-TRAMWAYS

FOR

INDIA.

AN INTRODUCTORY PAMPHLET

BY

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UNDER SECRETARY TO GOVERNMENT,
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ERRATA.

Page 23, 4th line from bottom,		*for*	"engenders"	*read*	"engender."
„	37, in Table II.	„	£2,640	„	£2,940
„	„ „	„	£25,000	„	£25,300
„	„ „	„	£2,500	„	£2,530
„	38, in Table III.	„	£3,520	„	£3,920
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STEAM-TRAMWAYS FOR INDIA.

CHAPTER I.

INTRODUCTION.

THE great famine in Bombay and Madras of 1876 to 1878 took every one somewhat by surprise and attracted very serious and very general attention. The loss of life was so great that pity opened widely the purse-strings of private benevolence; and the cost to the State was so enormous, that politicians eagerly inquired whether it might not have been materially diminished by the exercise of a little previous foresight. It was felt that the frequent repetition of such expenditure—and there is no particular reason why it should not have to be repeated somewhere at any moment—would precipitate the prophesied ultimate collapse of the Indian finances. So suggestions were freely offered as to the causes of famines, the proper way of meeting them, and their possible prevention in the future. An influential Royal Commission was also appointed who have issued a most exhaustive report on all the bearings of the question.

Speaking generally, remedial measures that have been proposed are divided into two classes: (1)

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Measures that contemplate the extensive creation of irrigation works; (2) Measures that contemplate a considerable development of the system of inland communication.

Advocates of the first system have a good deal of solid argument on their side, for they say, and very justly, that irrigation works confer permanent benefit on the country, and enable the individual cultivator to lay up a store of food against a dry day; whereas improved communications confer but little real benefit to the individual, and seldom pay a reasonable interest on the outlay upon them. Unfortunately, irrigation works fail most conspicuously when their assistance is needed most urgently. In a dry year, and still more in a succession of dry years, even the largest irrigation systems produce a reduced supply, and, moreover, the area protected by them can, at the best, bear but a ridiculously small proportion to the total area affected by an extensive famine. Only great rivers have any supply in dry years—small rivers, and of course all tanks, being perfectly innocent of water at such times—and the great rivers of India are limited in number. Moreover, even though food-grain may be stored in favoured regions in good years, and though it may be also produced in excess of the local demand in bad years, yet it is quite one thing to have the grain at the place of production, and quite another to get it, in the middle of a crisis, to outlying famine-stricken localities. A recommendation of some members of the Famine Commission is that large store-houses should be built for grain in important centres, so that a reserve may exist in times of scarcity. But it is unlikely that this idea will be carried into execution for it presents difficulties that need not be discussed here, and, in any case, the reserve would not constitute a sufficient supply dur-

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ing the recurrence of a period such as that of 1876-78.

Any one who had practical experience of famine-work during that time will know that one of the chief difficulties arose, not from the scarcity of grain, but from the impossibility of sending it forward with sufficient rapidity or in sufficient quantity from the ports, or stations of delivery, to the interior of the country. The block at the Madras port, or at Raichoor Railway Station where Bombay territory ends and that of Madras begins, in 1877, must have been seen to be believed. The grain was there and in abundance; it came from Burmah, from Calcutta, from the Central Provinces, from the Punjab, but it lay there for days owing to the hopeless block on the lines of rail. Merchants up-country had plenty of demand for grain, but they could only obtain it with great difficulty and at enormous expense, so the price when it reached the consumer was raised very much beyond what it would have been, had the ready demand met with an equally ready supply. And the lines of price and the lines of mortality rise and fall with unerring synchronism in famine tables. Neither when the grain reached the up-country railway station were the difficulties ended. Bullocks had died in thousands, and the means of transport were thus rendered scanty,* so that it may be said that people died of hunger with the food at their very doors. The remedy for this state of things, say the advocates of the second of the abovementioned systems, lies in the development of

*In time of drought and famine the substitution of mechanical for animal power for purposes of transport is another very important advantage which it is not possible to reckon by any money standard. (Chapter V, Section 4, para. 3 of Part II of Famine Commission Report.)

The cost of transport by cart is estimated at five times that by rail in ordinary times, but it will increase to ten times as much during famine. (para. 4 of same.)

internal communication. The battle between the two systems has been hotly contested enough, but victory may be said to rest finally now with the latter, the expenditure on large irrigation works having been strictly limited by the Secretary of State, while the railways of the country are about to be largely developed. For example, in the current year, out of the £2,500,000 to which the total yearly expenditure on Productive Public Works is now limited, £1,780,000 are to be spent on railways and only £758,000 on Irrigation Works. Moreover, it is believed that by far the larger share of the £750,000 which are to be yearly devoted to Protective Works will also go to the further development of internal communications.

Great encouragement has also been held out to private capitalists to embark in Indian ventures, which are understood to mean principally, railways. Para. 179 of Part I of the Report of the Famine Commission runs:—

"The future power of the country to resist" "the pressure that arises from drought is so" "immediately dependent on the improvement of the" "means of internal communication, that it is, in our" "opinion, impossible to exaggerate the importance" "of striving to accomplish this in every practicable" "way."

The railway-system of India is fairly complete so far as the great trunk-lines are concerned, but this is about all that can be said. The real function of railways is to bring about the closest possible alliance between the producer and the consumer, and this can never really be attained until all the principal tracts of country are within easy reach of a line of rail. There are still many important pro-

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ducing centres in India, which are situated miles and miles from any ready means of communication with the outer world; and the food-produce, which is there in excess, does not really benefit the consumer, the expense of carriage making any reduction in price to him impossible.

Remedy this state of affairs, it is said; run light and inexpensive lines of rail from the trunk-lines into these districts, their surplus produce will then be rendered available, one of the great famine difficulties will be solved, and the resulting development of trade will increase incalculably the wealth of the country in ordinary years. But the fatal objection is at once raised. "Where is the money to come from?" The Government of India have not got it at their disposal; private enterprise will not step in unless a substantial guarantee is promised; and Government have almost renounced the principle of guarantees. Why? Because it has been shown by experience that but few of the trunk-lines will ever work up to their guarantee, and that it is quite certain that feeder lines, as they are called, will never do better, if so well, as the trunk-lines. It is scarcely probable that even a light line of railway in India will ever be constructed for much less than from £6,000 to £7,000 a mile; and, at this rate, and with the expenses of working and management as high as they must necessarily be, it is impossible, on any reasonable estimate of traffic, to show any satisfactory percentage on the expenditure. India is a poor country; so much is at last happily acknowledged; and the inhabitants of India have their travelling idiosyncracies, which ought to be recognised, but often are not. So that in the first place travelling, for people as well as for goods, must be cheap, and in the second place its methods must coincide with the wishes of the people.

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Nothing makes travelling so popular as making it easy. A man living 10 miles from a railway remains contentedly at home. Bring the railway to his door and he will think that a journey is the one thing he has always needed to complete his happiness. So also with goods. A producer has a surplus stock, but carriage being difficult, he sells it to the nearest middleman at the local rate. The latter, who does things largely, sends it off to a trade-centre and makes a handsome profit. Improve the means of carriage, the producer then sends his stock direct to the trade-centre, and he benefits, even though prices there fall to the advantage of the consumer.

We thus come to this—that improved communications, or, let me say once for all, railway feeders, are highly desirable, but that even light lines of rail are, in most cases, too expensive to be practicable. Is there any alternative? I think there is, and that it is to be found in steam-tramways. The reasons for this opinion will be indicated in the next chapter.

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CHAPTER II.

HISTORICAL AND DESCRIPTIVE.

TRAMWAYS generally are of quite modern origin, and steam-tramways in particular may be said to be still in the earliest stage of development.

To America belongs the credit of being the pioneer of this new mode of locomotion. They were adopted there long before they became popularised in Europe, and in large American cities tramways have now replaced almost all other means of conveyance. For instance, in some streets of New-York there are four lines of rail, along each of which cars pass at intervals of two minutes. But in England, vested interests and the dislike to novelties long prevented the introduction of the system, and it was not till 1860 that the first tramway was established at Birkenhead. It was not till 1869 that the vestries of the suburban parishes of London were forced, by the pressure of public opinion, to grant concessions to Tramway Companies, and even now their operations are confined to the suburbs, no tramway running into the heart of London. In Paris the first important tramway was not established till 1875, but a start having been once made the after-growth has been very rapid. This indeed is true generally. At first the public were suspicious, and Municipalities and Corporations imposed hopeless conditions on would-be concessionaires. But the system was too good not to be successful. A few examples sufficed to show that a method of quick, pleasant, and cheap travelling had been secured,

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and one town after another became so eager to obtain these advantages for itself, that now there is scarcely a place of importance that has not got its tramways completed, in progress, or projected.

Horses were at first solely used for traction on tramways, but their prime cost is so great, and their employment involves such difficulties of up-keep and management, that numerous attempts have been made to replace them by some method of steam traction. These attempts have not been very successful hitherto, as the use of steam-power on public roads is subject to such stringent regulations, that it has not been found possible to comply with their conditions. The smoke, the noise of the engines, and the difficulty of controlling them, are all exaggerated, and are supposed to present so many annoyances to the general road-traffic, that a form of locomotive power which will successfully meet all these objections has hitherto been considered a *sine quâ non.* Compressed air engines have been tried on numerous occasions, but with only a moderate measure of success, and there can be little doubt that eventually public opinion will change, the objectors will have to yield to the force of example, and that steam will triumph.

As a matter of fact, the anticipated dangers resulting from the use of steam are purely chimerical. Steam-cars are in use now in many cities of Europe and America, and not the slightest difficulty or danger is found to result from their employment. Any Anglo-Indian may verify the truth of this assertion for himself without much trouble. He probably knows Turin. The next time that he halts there on his way to or from England, he may see steam tram-cars running up the Via di Po, the principal street in the town, and into the Piazza

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di Castello. In this case scarcely any precautions are used to lessen the noise or the smoke of the locomotive. The train of passenger cars is drawn by a separate locomotive, which would certainly look a strange object to a horse the first time he saw it, but which, in Turin, all horses now pass with the utmost indifference. Horses in towns but rarely shy at objects; so many things are strange that they merge all into a general indifference. Noises they do mind, but the noise made by a steam-tramway going at a slow speed is almost inaudible.

So far reference has been made only to tramways in towns, but with the example of steam traction engines before them, and with the principle of steam-tramways admittedly successful, it was evident that the pioneers of the new enterprise would soon turn their attention to the possibility of successfully serving country districts. It was the logical sequence of suburban tramways—first to bring the outlying portions of a city into easy communication with its centre, and then to bring the means of locomotion to the environs and outlying villages. They were obvious difficulties in this extension, for tramways to be successful must be cheaply constructed, *i.e.*, they must be able to utilise the existing roads, which, in turn, involves the absence of any steep gradients on the latter. Also, being at first designed solely for passenger traffic, it was necessary that the flow of passengers should be fairly continuous and their numbers constant.

The first country tramways that have been introduced into Europe on a large scale are accordingly in a country where all these conditions are fulfilled,—the north of Italy.

The plain of Lombardy, with Milan as its centre,

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formed the place of all others for such an experiment. The country for miles around Milan is almost perfectly level; the roads are numerous and good; there are many surrounding villages all filled with a large and busy population; and lastly, and this is a point of no small importance, the country is very little intersected by railways. The first Milanese tramway was only laid down, to the best of my knowledge, about 4 or 5 years ago, but, at the present moment, there are 200 miles of rail branching out from Milan on every side along fifteen of the principal roads, and running in some cases as far as 30 miles into the country. Steam-tramways exist of course in considerable numbers in other countries, especially in America, Germany, and France, but they have no where reached as yet the same stage of development as in Lombardy. I recently had a very advantageous opportunity of studying the working of the Italian system. I made Milan my head-quarters for several days while I was making an official inspection of the important Irrigation works in the neighbourhood, and every day I went to the head-works, or to some point of interest on the various canals, by means of one or other of these lines of tramway. I also had what may perhaps be called exceptional advantages for studying the details of the working of one of the Companies; and, as any system of steam-tramways in India would certainly be based to a considerable extent on the results of these Milanese lines, I will proceed to indicate some of their more important features.

The line that I will take as typical was opened in June 1878, has a length of main line of 18·64* miles, and runs along a fine straight road about 20 feet broad with a slight and steady ascent out of Milan. There is only one dif-

*It has in addition a branch of 9·8 miles opened last year.

ficult point in the whole line, where the road ascends sharply over an arched bridge across a navigation canal. The use of the portion of the road required by the tramway was granted gratis by the Provincial authorities to whom the road belongs. In some other cases however an indemnity has been claimed by the proprietors of the road. The Company is only obliged to keep in order that portion of the road which is occupied by the tram, and as the gauge is 4′, 8″½, which is the same as that of the Government railroads, about 7 feet is about the width for which the Company is responsible, allowing a small margin outside the rails on each side.

Government sanction has nominally to be obtained before a tramway concession can be taken up, and Government surveillance is exercised when the line is working, but neither of these points are very strictly enforced up to the present. The Italian Government has shown itself to be very unselfish and very discriminating in the matter. Unselfish, because as proprietor of the railroads, the tramways enter into direct and, I may add, successful competition with it; and discriminating, because it has recognised the importance of securing to the province the utmost possible development of the system, and has therefore declined to strangle its birth by any vexatious regulations or stringent control. As a matter of fact, the rails of some of the new trams have been laid down before the sanction of Government to the concession has even been asked for, and the Bye-Laws framed by the Companies are not interfered with, except so far as to see that the public safety is duly considered. This latter point is secured principally by limiting the maximum speed of the steam-trams to 11 miles an hour. This point brings out well the perfunctory nature of the Government control, as, on every line, the trains run to a speed

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of certainly 15 miles an hour and probably more. In fact their printed time-tables are boldly based on a higher rate of speed than is allowed by regulation. It is known however that it is the intention of Government, as soon as the trams are as fully developed as is reasonably required by the needs of the province, to bring in a law strictly defining the right of tramways, which will be rigidly enforced. The Companies at present are therefore only in the state of "making hay while the sun shines."

As a matter of convenience the Company does the repairs to the whole breadth of the road, receiving an annual subsidy from the Provincial authorities for the up-keep of their portion of it.

The capital of the Company to which I am more particularly referring, consists of £40,000 worth of fully paid up shares, and of £10,000 worth of debentures. There are 4,000 shares of £10 each, and the market value of each is now £16, which sufficiently indicates the prosperity of the Company. A large amount of foreign capital is invested in the Milanese lines.

The cost of the main line was about £2,300 per mile including rolling stock and all incidental expenses, divided as follows :—

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	£	£
Preliminary Expenses.		
Inauguration	219	
Indemnity to Concessionaires	880	1,740
Sundries	641	
Buildings, &c.		
Station at Milan	5,517	
Terminal Station	616	7,886
Other buildings	60	
Legal expenses	1,693	
Permanent way		21,121
Carriages and Trucks		5,901
Locomotives		5,897
Office Expenses		282
Tools, &c.		266
Sundries...		208
	Total...	£43,301

The buildings at Milan comprise workshops for the repair of the rolling-stock, and sheds in which it can be housed; also a small station, but regular station-buildings are not required, tickets being taken *en route.* At the other end there is a housing shed; but at other places, the train simply draws up in the principal street of the village, opposite the "Albergo di Tramway," which suffices as a rallying point for passengers.

The permanent way is supposed to be laid down flush with the road, and is so through towns and villages, but in the country there is a drop of nearly an inch between the rails, from the top of the rail to the roadway, which makes it very unpleasant, if not impossible, to utilize the between-rail portion for ordinary traffic. No doubt the Companies have made their permanent way like this intentionally,

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so as to keep road-traffic off their lines and so to save wear and tear, but when the Government Regulations are framed, this omission will have to be rectified. The rails are of Vignoles section, made of Bessemer steel weighing 36·28lbs. per yard, clamped on to cross-sleepers of wood. In towns and villages there is a longitudinal sleeper above the cross-sleeper, and the rail is then clamped on to that, a guard rail being also employed. There is also a guard rail round all curves, the minimum radius of which is 131 ft. The steel rails cost £9 16s. a ton. The cost of up-keep of the permanent way varies from £16 to £19½ per mile per annum, but the details of receipts and expenditure during one year will be shown in a copy of the balance-sheet later on. The line is only single—there is no double line of steam-tram yet established anywhere in Italy—but there are shunting stations at the principal villages, where trains can pass each other.

There are three classes of passenger carriages, besides goods-trucks and goods-vans. The passenger carriages are divided into;

1st class, which weigh 51·18 cwt., are 19·7 ft. long, 8·86 ft. high, and carry 16 inside passengers, besides from 12 to 16 passengers on the platforms at each end;

2nd class, which weigh 49 cwt. are of about the same dimensions as the 1st class, and carry 22 inside passengers and about the same number of platform passengers;

open-side carriages for summer use, which weigh 43 cwt. are 22·3 ft. long, and carry 32 seated passengers.

The carriages cost on an average £200 each, and there are altogether 40 at work on the line at

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the present moment, some having been purchased since the Company was first started, on the construction of the branch line abovementioned. One or two American carriages were imported and were much liked, but the Belgian make is well spoken of, and Grondona of Milan also turns out good ones.

There are altogether 8 luggage trucks and vans on the line, but the goods-traffic is small at present, consisting chiefly of milk and garden produce for the markets of Milan.

The locomotives are mostly of Swiss or German manufacture coming from Zurich or Cassel. They have very much the appearance of a high box on wheels, being covered in as much as possible so as not to frighten horses. They are of the ordinary direct-acting outside-cylinder type, weigh from 6 to 10 tons, develop from 20 to 30 H. P., and work at a nominal maximum pressure of 118 lbs. on the square inch. As a matter of fact this is exceeded, and I saw several working up to 10 atmospheres, or 147 lbs. on the square inch. They cost from £640 to £800 each, and there are 12 now at work on the line. They all burn coke, patent-fuel being said to give out too much smoke. Coke costs about 36*s.* a ton at Milan.

The total number of miles run in 1880 was 128,889, and the total cost of running was £4,283, or nearly 7·9*d.* per train-mile, which includes the lighting of carriages, wages of servants, &c.

As regards the locomotives alone, the average consumption of fuel in each for each mile run, is 10 lbs. of coke, 1·1 lb. of wood, and ·18 lbs. of oil. The fares are 1·13*d.* per mile 1st class, and ·64*d.* per mile 2nd class. The goods rates are fixed so as to be between the express and slow-train rates on the neighbouring lines of rail. There are 6 trains each way every day, extra trains being run on Sun-

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days and holidays. There are 7 stopping stations between Milan and the Terminus, and, at intervals between these stopping stations, poles are placed, at which people who wish to be taken up may take their stand. The tram will stop for them there, but not at other places, as it is well known that frequent stoppages cause a great loss of power, equal, it is estimated, to half a mile of running for each stoppage. These intermediate stopping-places appear, however, to be very rarely used. The engines can stop the trains dead in about 25 yards.

The trains consist of the locomotive, which has an engine-driver and a boy to look after it, and generally of one 1st class, one 2nd class, and one open carriage, with perhaps a goods-van. One conductor and one check-taker look after these. There are in all 33 subordinate employés on the line. The ticket-system is as follows; all tickets are given in the cars, the conductor being provided with two rolls of narrow paper which are marked off into divisions, each representing 2½*d.* for the 1st class, and 1½*d.* for the 2nd class. All fares are in multiples of these, and he gives each passenger the number of divisions his fare represents. The check-taker follows the conductor, and to him each passenger gives his slips which he tears in half and throws away. At the end of each trip, the number of divisions issued by the conductor is counted by the cashier, and he hands over the equivalent sum. Season tickets are given, but there were no return tickets on the line in question till September last. The above system is said to answer well and there is but little fraud. I may mention, by the way, that the most successful means of checking fraud get discovered is on the Bombay horse tramways, that are the property, I believe, of an American firm. There is a monthly drawing of prizes, in which each ticket taken has a

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chance of several very handsome sums of money, so that naturally every passenger insists on having a ticket.

The principal traffic on the Milanese lines is between October and May, and there is steady influx of country people into Milan on market-days, (3 a week), and many also come in to see their friends in the famous free hospital at Milan which contains 2,500 beds.

The maximum gradient on the line is 1 in 20, which is about as steep as an ordinary locomotive can manage with an average train. On the Tivoli tramway at Rome there is a steady continuous ascent of about 1 in 33 with a reversing station. It is supposed by the Milanese authorities that a tramway would not be likely to pay for a short distance, say under 10 miles, unless there was a very large passenger traffic, such as that to some pleasure resort. This is well exemplified by the Turin tramways, which do not run far out into the country, but only through and round the town, and out to a country resort 7 miles from Turin. They only run about 7 miles an hour, but do not differ materially in other respects from those of Milan. They use the ordinary horse-tram rails in Turin.

The country tramways are said to draw all the traffic to them for a distance of at least 2 miles on either side of the line. This distance sounds small, but the richness of the country and the multiplicity of its roads must be carefully borne in mind. It has already been said that where they run parallel to, or near the railways, the latter suffer much from the competition. An instance was given me of a horse-tram that was established 10 years ago to a place called Moriza, 12 miles from Milan, which has caused a total loss to the railway running to the same place of £24,000.

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The following is an abstract of the balance-sheet of the Tramway Company I have been describing. It will be observed that the taxes from an exceptionally heavy charge, there being an income tax of 13 per cent., besides taxes on carriages, sheds (house-tax), and Railway Traffic tax. The total taxation is about 20 per cent. on the net income. No one who knows Italy needs to be told of how heavily the burden of taxation weighs there, many landed proprietors having to pay in all nearly 50 per cent. of their income in taxes. However it is the penalty a poor country has to pay for being great, but, in spite of it all, there are plenty of Italians who raise the cry of "Italia Irredenta," and who wish to go to war with France about Tunis.

BALANCE SHEET OF A MILANSE STEAM-TRAMWAY COMPANY FOR 1880.

Receipts.	£.	£.
Passengers	12,369	
Goods	364	
		12,733
Interest...		81
Contribution from three hamlets ...		194
Compensation for damage to Cars ...		14
Postal Service		81
Discount and Rebate		115
Sundry Receipts		126
Gross Receipts...		£13,344
Gross expenditure...		£10,784
Net Receipts...		£2,560

That is the gross expenditure is equal to 80·8 per cent. of the gross receipts.
Total length of tramway, 27·94 miles.
Train mileage, 128,889.
Receipts per train mile, 25·6*d.*
Expenses do. 20*d.*

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EXPENSES.

			£	£
Rolling-Stock				
Depreciation.	Locomotives ...	...	603	
	Carriages ...	...	578	
	Buildings ...	...	48	
Consumption.	Coke	...	1,138	
	Wood... ...	...	102	
	Oil and grease	...	510	
	Leathers ...	...	26	
	Varnish, &c ...	...	53	
	Tools	...	46	
				3,104
Maintenance and Repair of Locomotives, Carriages, and Roads			790	
Depreciation of Permanent Way		...	1,786	
——— Workshops, &c.		...	16	
Cost of inauguration, &c.		... ...	131	
Assurances.	Fire	...	9	
	Accidents ...	...	28	
				2,760
Cost of Administration.	Direction	...	729	
	Office ...	...	18	
	Stamps...	...	7	
	Publishing	...	98	
				852
Taxes			586	
Lighting			28	
Rents			12	
Interest on Debentures			250	
Salaries			2,708	
Legal, &c., expenses			45	
Rewards			33	
Sundry losses			17	
Sundry expenses			389	
				4,068
	Gross expenditure...			£10,784

It will be observed that a fixed sum is paid to an Insurance Office which takes all risks as regards compensation to passengers for accidents on the line. The accidents have been but few and un-

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important hitherto, being confined to cars running off the rails round curves, &c. There are no night trains, by which much risk is avoided. The net profit is equivalent to a dividend of about 6 per cent., which is considered small in Italy. A certain amount has been put on one side to constitute a Reserve Fund. Analysing the figures given in the above balance-sheet, we find that the passenger receipts were made up as follows:

	No.	Receipts. £.	s.	d.
1st Class Passengers	299,490	3,031	7	1
2nd do.	1,453,052	9,004	3	4
Return Tickets		162	9	7
Season do.		81		
Special Trains...		64		
Reserved Carriages		26		
		£12,369	0	0

This gives the result that each 1st class passenger pays on an average $2\frac{1}{2}d.$, which is equivalent to a journey of 2·21 miles; and that each 2nd class passenger pays on an average 1·55*d.*, equivalent to a journey of 2·44 miles.

The mean daily receipts, from passengers and goods combined, is £40 8*s.* 8·6*d.* Moreover, the train mileage during the year having been as above stated 128,889, it follows that the passenger receipts per train-mile were 23·03*d.* and the goods receipts, ·677*d.*, or a total receipt of 23·707*d.* for each mile run; sundry receipts of 1·893*d.* bringing up the total to 25·6*d.*, as stated in the balance-sheet. Such are the principal details of the Italian steam-tramway system. It will be seen that they are virtually light railways running along the high-roads, and, in fact, an Engineer said as much to

me, "For all practical purposes we consider them as railways." But whether they are called rail or tramways does not much matter; they confer an enormous benefit on the district they traverse, and there can be no doubt that the system is capable of very large and profitable development in European countries, where the conditions are similar to those obtaining in the neighbourhood of Milan. The principal opposition to them arises from popular prejudice, but any one who has seen them at work in Italy must confess, that 6 or 7 feet of the roadway may very well be given up to a tramway at the side of most important roads, and that the tramway traffic, and the ordinary road-traffic of the country, are perfectly capable of being carried on side by side, without the very slightest difficulty or danger.

The following are some particulars of a steam-tramway between Cassel and Wilhelmshöhe in Germany, extracted from volume 52 of the Minutes of Proceedings of the Institution of Civil Engineers.

The line is 3½ miles long, on an incline of 1 in 16·6, and on a curve of 164 ft. radius. The rails are of steel weighing 36 lbs. to the yard.

There are two locomotives on the line of 20 H. P. each, weighing, with 2 tons of water, 9 tons. They burn 88 lbs. of coke for a double journey of 6·6 miles, running 7½ miles an hour. Each engine can draw two fully loaded cars up the incline, and in twenty-two days the two made 302 trips carrying 34,000 passengers. There had been, at the time the paper was written, no stoppages or accidents, and no cases of alarm to horses. The author considers that—"experience enough has been gained to "allow not only the relaxation of the legal restric- "tions to the use of steam-power on tramways, and "to sweep away horse traction altogether, but also

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"of a large extension of the system for light con-
"necting lines of railway to be laid at a small cost on
"common roads; the speed of these lines not to
"exceed 12 miles an hour, and the engines to be such
"as will require only a single attendant. The track
"should be of the best description with steel rails
"and iron sleepers; such a track can be laid com-
"plete at a cost per mile of £1,200 for material, and
"£300 for laying. Rolling-stock, such as used at
"Cassel, can be bought at the following prices;
"Locomotive, £500; covered car, £200; open car
"£125; and open goods waggon £75."

Let us now consider how far and with what modifications the system is applicable to India.

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CHAPTER III.

STEAM-TRAMWAYS FOR INDIA.

Tramways in Europe have hitherto been designed almost solely for passenger-traffic, the goods traffic even on those that were treated of in the last chapter being very inconsiderable, though capable of development. In India, on the other hand, it is fairly certain that if a country tramway is to be successful, it must traverse a line where the goods traffic is considerable, and succeed in drawing to itself the major share of the carrying trade.

The native of India is not a great traveller, and for short journeys between village and village he has his own means of conveyance, and prefers to make his journey at his own time, so that a tramway might not attract a very large proportion of passenger traffic. Even in Indian cities, tramways have not always proved successful, as we in Madras know to our cost. True, the Madras Company failed chiefly on account of faulty management, and there is the example of the Bombay Company to prove that town tramways, if well managed, may yield handsome profits even in India, but a country tramway here would never return a profit from passenger traffic alone. It has already been said that travelling facilities engenders travelling desire, and so no doubt the passenger traffic on a country tramway would go on increasing, if the line was judiciously chosen.

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And there would not be much ground for hesitation as regards the choice of the best lines. There are many towns lying at a moderate distance from the lines of rail, between which and the nearest station a very large traffic exists, which is urgently in need of some more expeditious mode of conveyance than that provided by the cumbrous bullock cart. In the Madras Presidency, every one can call to mind numerous such instances. The South-West line of the Madras Railway took expressly, as is well known, a line running some distance from the principal towns of the districts it traverses, and consequently Arcot, Vellore, Salem, &c., which are all centres of a considerable trade, are quite disconnected from the railway. Nellore and Kurnool on the Bombay line are also far distant from railway facilities, though each is the centre of a large producing region. Again, in connection with the South Indian Railway, the road between Madura and Ramnad has already been subject to the proposal of a light railway line, though the project has been temporarily shelved on account of the cost. The connection of Tranquebar with Mayaveram is another instance. In Lower Bengal too, where the country is so thickly populated, a very great need is felt for some better method of carriage than at present exists. It is not unlike Lombardy in its flatness, its richness, and in the large proportion of its inhabitants to its area, so that if steam-tramways ever become successfully established in India, it will probably be here, as in Lombardy in Europe, that they will be most largely utilized and most profitably worked.

However, it is too early yet to discuss the question as to where tramways might be established, for we have first to show that they are capable of being established at all with a reasonable prospect of success. I shall have to deal with figures to a certain

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extent, when discussing the movement of passengers and merchandise in the country, and I shall take for my purpose the published returns of traffic on some of the principal Indian railways. This will be disadvantageous to the tramways in some measure, for it is very generally admitted that, most Indian railways have not yet succeeded in drawing to themselves so large a proportion of the general traffic of the country, as had been anticipated. Perhaps the native has not quite realised yet the advantages offered by a railway, or perhaps the Railway Companies have not, in some cases, consulted sufficiently the peculiarities of the native character. Anyhow the fact remains. In tramway management, on the other hand, the system would be on such a very much smaller scale, that fares, time-tables, &c., might be altered constantly without much difficulty, till the convenience of the majority of the travelling public had been satisfied, with the result of a better chance of relative success than has as yet fallen to the fortune of railways.

The first question to be considered is the position that Government would assume towards the new enterprise, should any proposals for its trial be brought forward. The principal points are;

(1.) Would permission be given to the local authorities to grant the use of their roads?

(2.) Would a reasonable rate of speed be authorized?

(3.) Would interbooking between tramway and Railway Companies for passengers and goods be adopted on State, and encouraged on guaranteed railways?

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(4.) Would Local Fund Boards and Municipalities be encouraged to guarantee a moderate rate of interest to the undertakings?

Let us briefly consider each of these points.

(1.) Would the use of the roads be granted?

It would be scarcely worth while to consider the feasibility of making a tramway a paying concern, if this concession were not made; for it would burden the Company hopelessly at the outset, if it had to purchase land and to make all its own embankments, cuttings, and bridges. I will therefore assume that the use of the roads would be granted under certain conditions, and turn to,

(2.) The rate of speed allowed.

The conditions here would necessarily be somewhat different to those existing in Europe. There, foot-passengers are comparatively rare on the roads, nor is there anything approaching the same amount of cart-traffic as in India. Also the existing cart-traffic is better organised, and you do not, for instance, come across the long interminable lines of carts, often hopelessly intermingled, that are so common here. In Europe the road-traffic looks out for the tramway; in India the tramway would have to look out for the road-traffic. That is about the difference. The best way to conduct the traffic safely at a moderate rate of speed would be to allow the Company to fence off that portion of the road occupied by its line, but it is highly improbable that this concession would be granted in many instances, or, indeed, that the existing width of road would render it possible to grant it. On the other hand, a fair rate of speed is an essential condition of success, for to secure the passenger-traffic, the tramway

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would have, at any rate in Southern India, to compare favourably as regards fares and speed with the little two-wheeled vehicles, locally called "jutkas." These run at about 8 miles an hour, so that a speed of at least 10 miles an hour would have to be maintained. No doubt at first the running would have to be conducted with much caution, but as, at this rate of speed, the cars could be stopped dead in a distance of 70 feet, there should be no danger about it. Moreover, when the hours of passing of the tramway became known, the native bullock-drivers would soon learn to be on the look-out for it. The Italian locomotives are provided, some with a powerful steam-whistle, and others with a horn blown by the driver, to warn carts of the approach of the tram. I may also add that the driver sits at the front of the locomotive, where are placed the brake-handle, and that for shutting off steam, so that he has his train absolutely under control.

(3.) Would interbooking between tramway and Railway Companies be adopted?

This again I consider as an essential feature of success. It has been said that in most cases—at first certainly in all cases—tramway lines would serve as railway feeders, and unless they were really treated as such, the commercial and travelling public would never take to them. If at the railway station, rebooking, reweighing, and all the other formalities had to be gone through a second time; the trouble, the delay, and the general friction, would be so many impossible barriers to success. It may even be said that to be really successful it ought to be possible to pass railway waggons in case of need over the tramway lines. This involves however the difficult question of gauge which will be referred to presently, and, in the meantime, I will only assume

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that the above-mentioned facilities would be readily accorded, as being of as much advantage to the railway as to the tramway.

(4.) Would a moderate guarantee be authorized?

This is really the kernel of the whole affair. Naturally, in writing of tramways, I am not putting a purely hypothetical case of possibly successful enterprise. There are capitalists in Europe who have already been profitably connected with Tramway Companies, and who would be willing, if a favourable opening could be shown to them, to put themselves at the head of similar enterprises in India. "But," they will certainly say, "India is an uncer-" "tain country at the best, and in the case of a new" "class of undertaking it is quite an unreliable" "country. Tramways may prove a success, or they" "may not. We are willing to make a trial, if we" "are guaranteed against total loss."

The present policy of the Government of India, as announced in the Hon'ble Evelyn Baring's Financial Statement of March 25th last, is opposed to guarantees in principle, but still admitting them to a limited extent in practice, should it be found that private enterprise, which is to be encouraged by every legitimate means, is so timid as not to venture forwards without this helping hand. And private enterprise is timid; justly timid, I may add. But without a guarantee it is improbable that there will be any tramways. The position is certainly a difficult one, for there are very few Municipalities that will be in condition to offer any guarantee to a Tramway Company, which will affect their incomes enormously by largely reducing their toll-fees. I may safely take half of the total income as being the proportion which many Municipalities derive from tolls; and, if the effect of a tramway is to reduce the tolls by half, each

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Municipality will look to the Company for an equivalent compensation, and will not hear of a guarantee, much as they may desire to see their communications improved. The only plan would be to introduce octroi duties, which are levied in almost every continental city, but to which the Indian Governments have always been steadily opposed. But suppose octroi duties were sanctioned, and the Municipal finances balanced in this way, the difficulties of a guarantee would almost disappear.

Take the case of a line 5 miles long connecting a Municipal town of 20,000 inhabitants with a railway station, and suppose the income of the Municipality to be Rs. 20,000, and that of the Local Fund Board of the circle to be Rs. 50,000. The line of tramway might require a capital of £20,000, to put an extreme case, on which interest at 3 per cent. would amount to £600 a year, which might be jointly guaranteed by the two Boards.

It will be seen that the introduction of tramways is not by any means a simple affair, and would involve many concessions on the part of Government. Let me also add, that they would require very judicious treatment. Capitalists are frightened, not only at the uncertainty of enterprise in India, but at the vexatious control to which it is subject. No doubt zeal for the public interests and for the public safety are admirable qualities in a Government Officer; but they may be carried too far. Men, who have dealt with important concerns in western countries, come here, and sometimes find that they are treated with a suspicion that they resent, or are hampered by a control which they find unendurable. If a tramway concession is given, let the official regulations for it be drawn up most carefully, though in a liberal spirit, in the first

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instance; and let them then be left unchanged, as far as possible, so that concessionaries may know exactly the conditions they are bound to conform to, and not have to depend on the continuity of purpose of successive supervising officers.

I cannot do better than quote here the remarks on the subject of encouragement of private enterprise made by the Hon'ble Evelyn Baring in paras. 84 to 91 of his Financial Statement.

84. It is, however, manifest that a capital expenditure of £2,500,000 a year is inadequate to meet the present wants of India. Are we therefore to abandon all hope of constructing canals and railways with the rapidity which the exigencies of the country demand? I hope not. It has always appeared to me a remarkable fact that India,—with all its magnificent and, as yet, only half-developed resources, and with all the security to life and property resulting from a Government, which, whatever be its defects, is at all events strong, honest, and well-intentioned,—should up to the present time have been obliged to pledge the full security of the State in order to attract any considerable portion of the surplus capital of England. I hope that some railways afford sufficient attraction to induce private individuals to undertake their construction without the aid of Government, or, at all events, with a minimum amount of such aid. I do not question the wisdom of the policy which would permit private capitalists to embark in this field. It was therefore with pleasure that I read the following instructions which have been received from the Secretary of State:—

"In the case of railways, I do not doubt that Your Excellency will bear constantly in mind the importance, whenever possible, of ensuring their construction by private capital, either local or European. It is true that up to the present time no Companies have been found willing to undertake the construction of railways without a Government guarantee; but I would, nevertheless strongly urge upon Your Excellency that, when any reasonable prospect of success presents itself, an endeavour should be made to encourage the raising of capital through private agency, on the exclusive security of the success of the undertaking. Any step in this direction will meet with my most cordial support and co-operation. In the event of its becoming apparent that the due execution of this policy is impracticable, it may become

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desirable to consider whether a modified system of guarantee might not advantageously be adopted. By a modified system I mean one so restricted in respect to time and to the rate of interest guaranteed as to give the subscribers a real interest in the efficient and economical administration of the railway."

85. It is sometimes urged that a railway is a monopoly, and, for that reason, should be in the hands of the State, and not of any private interests. Further, that to concede the right of building a railway is to part with one of our most productive resources.

86. It is true that a railway is generally a practical monopoly. The State, therefore should exercise so much supervision over its working as will prevent the monopoly being exercised in a manner detrimental to the public interests. Thus the State should possess a right of inspection, in order that the line may be certified by competent authority to be safe for the transport of goods and passengers. It should regulate the maximum tariff and fix the gauge on which the line is to be constructed. It is especially necessary that a conditional right of purchase after the lapse of a certain period should be reserved. But when provision has been made for these and some other points, which I will not now enumerate, the necessity for State interference ceases. The interests of the public do not necessarily demand that the State should create an artificial monopoly in its own favour in respect to the construction of all railways.

87. As regards the loss of revenue, it may be urged that if the profits of the railway be left to fructify in the pockets of the people they will be more advantageously employed than would be the case were they paid to the State, with a great chance of their being employed on unproductive expenditure. Moreover it is to be observed that the indirect benefits to the State and to the country resulting from the extension of railway communication are obtained equally well whether the railways are constructed by Government or by private agency. The value of land is enhanced; new markets are opened; an impetus is given to the export trade, and the greater power of transport and concentration affords a hope that military expenditure may be reduced.

88. Even if the general arguments in favour of constructing railways solely through the agency of the State were more valid than I conceive them to be, I should still hold that those arguments did not apply in India. The first economic requirement of India is that her resources should be developed without delay,

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and that means of communication should be so improved as to facilitate emigration from districts which or over-populated to those in which labour is scarce. I doubt whether Government agency alone can adequately perform this task, and I hold that in any case it is not desirable that it should do so if private agency can be found to undertake the work. I am not without hope that, if an impulse can be given to railway construction by British enterprise, Native capitalists will enter the field, either alone or in conjunction with Englishmen. I should regard such a movement as an important factor in the practical education of the people, inasmuch as it would tend to wean the Natives of India from that dependence upon Government which is intensified by concentrating in the hands of the State all the organised skill which the construction and management of a railway requires. If ever the Natives of this country are to be schooled in the first rudiments of self-government, it is desirable that they should be encouraged to act for themselves in such matters, rather than that they should rely always upon that coercive philanthropy which insists upon doing everything for them.

....

91. I am unable as yet to say anything definite as to the conditions under which concessions may be made to private capitalists. Possibly those conditions may vary according to the exigencies of each particular case. It appears to me, however, that the Government may legitimately help in a variety of ways short of giving a guarantee. Government officers may make surveys and estimates, and supply all necessary information with a view to enabling private individuals to judge for themselves whether they care to invest their money in any particular scheme. The land on which the line is constructed may sometimes be given free of cost. Possibly, in some cases, grants of waste land in the vicinity of a new line may be given. On the other hand, certain conditions, to some of which I have already alluded, must be imposed, and it will be important only to give concessions to such persons as can afford good security that they have at their command a sufficient amount of capital to carry out the undertaking to a successful issue.

It will be observed that the Finance Minister refers almost solely to railways, but, as has been previously mentioned, steam-tramways are still quite in their infancy, and possibly he had not thought of them as being a method of inter-communication in India, more suitable perhaps than even light rail-

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ways. The views of the Government of India thus authoritatively enunciated give every possible encouragement to private enterprise, and, as has been already implied, I have not contemplated a Government guarantee to the undertakings, at any rate at the commencement. I would rather let the enterprise depend on the support of local authorities, who have the best means of judging, and who are the most interested in judging rightly.

This brings us to the construction of tramways.

They might either be laid down by the local authorities themselves, or else a concession might be given to independent capitalists for their construction and maintenance. The latter case is the only one worthy of consideration, but the position of the local authorities in the matter has so far to be considered, that they will certainly have to invite the attention of the capitalist to the opportunity that may exist for a profitable undertaking within their jurisdiction, and they will also have to decide on the terms they are prepared to offer him, and the reservations they may determine to make in their own favour.

The possibility of making a tramway a paying concern will depend:

(1) on the original cost of its construction.

(2) on the traffic returns.

The estimated cost of construction must be based on the cost of similar concerns in Europe, with such additions as the freight, &c., of the plant will entail. This additional cost may be calculated with sufficient exactness from the corresponding figures for the Indian railways. The use of the roads is as-

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sumed, subject to such conditions as are specified hereafter, and it is also assumed that the road is bridged throughout, and that the bridges will be capable of carrying the tram as they are, or with but such additions as may be made at a moderate cost. Finally there is the question of gauge.

I have said above that there would be certain obvious advantages could the railway trucks be run, in case of necessity, over the tramway lines. Conversely there would be many advantages could the tramway rolling-stock pass over the railway lines. The locomotives, carriages, and waggons could then be set up at a moderate rate in the railway workshops at the sea-port, and could be run directly on to the tramway; repairs could, on occasion, be done in the same way; and the tramway trucks could load and unload in the railway sheds and sidings.

A special form of rail, and perhaps also a wheel flange differing somewhat from that usually employed for tramway-cars, might have to be adopted to render these desiderata possible, as experiments made in Glasgow have shown that, to allow railway waggons to pass easily over ordinary tramway lines, the gauge of the latter should be ·787 inches less than that of the ~~former~~. railway

On the other hand there would be many disadvantages attendant on the adoption of the standard gauge of Indian railways for tramway lines.

The gauge of almost all European lines is $4'\cdot 8\frac{1}{2}''$, the same as that of the railways, and scarcely any lines have been constructed of a broader gauge, with the one exception of the Dublin tramways which are of the Irish railway gauge of 5′ 3″. If one had to select the gauge the most suitable for India on the grounds of efficiency and economy, it is probable

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that one would choose the metre gauge, which would, I may remark, be adopted in any case for all tramways running in connection with narrow gauge railways. The 5′ 6″ gauge would entail a large additional cost of up-keep, on account of the additional width of roadway to be maintained; the prime cost of the rolling-stock would be enhanced, as designs and patterns would have to be specially prepared for it; and, lastly, it is probable that on many roads the necessary breadths of road and bridges could with difficulty be spared. On *primâ-facie* grounds therefore, it would appear that the disadvantages of the 5′ 6″ gauge exceed its advantages, and that Tramway Companies would decline to adopt it. On the grounds of general convenience however, and on those of public policy, no other gauge could be admitted on the lines running in connection with broad-gauge railways, and it is likely therefore to be one of the principal conditions of the proposed guarantee, that the standard gauge shall be adopted.

The last chapter gave with sufficient detail the approximate initial cost of Steam-tramway Lines in Europe, and, in the following table, I have made out approximate estimates based on those details for lines of 5,10, and 15 miles in length, for India. It is improbable that any line would be established shorter than the first, or, at the commencement, much longer than the last of these. All calculations have been made in £. *s*. *d*. for convenience of comparison with European and Indian Railway returns.

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I.—*Approximate Cost of 5 miles of Tramway, 5'. 6" gauge.*

		£	£	£
	Permanent Way.			
1	Cost of re-formation of road, including strengthening of bridges where necessary, at £300 per mile (5 miles) ...		1,500	
	Bessemer-steel rails, weighing 35lbs. a yard, 55 tons per mile, at £7 per ton ...	385		
	Iron sleepers, 70 tons per mile at £3 per ton ...	210		
	Add 40 p/c for freight, &c. ...	238		
	Laying Permanent Way at 2*s.* per yard, per mile ...	176		
	per mile £	1,009		
	For 6 miles, to include sidings, and circular sweep for reversing locomotives at each end, and extra curves ...		6,054	
				7,554
	Locomotives.			
2	Three locomotives, each of 30 H.P., weighing 10 tons each, at £700 ...		2,100	
	Add 40 p/c for freight and fitting up ...		840	
				2,940
	Carriages and Trucks.			
3	One combined 1st and 2nd class car ...		240	
	Four open cars at £150 ...		600	
	Two closed vans at £120 ...		240	
	Twelve open trucks at £100 ...		1,200	
			2,280	
	Add 40 p/c for freight, &c. ...		912	
				3,192
	Carry forward ...	...	...	13,686

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I.—*Approximate Cost of 5 miles of Tramway, 5'. 6" gauge.*

		£	£	£
	Brought Forward. ...			13,686
4	Sheds for rolling stock at one end, repairing shop, necessary offices, &c. ...			750
5	Payment to Concessionaires ...		250	
	Compensation ...		500	
	Legal, &c. expenses ...		250	
				1,000
6	Fitting up offices ...			100
7	Tools, &c. ...			100
8	Sundry expenses ...			364
			Total £...	16,000

or
£ 3,200 per mile.

II.—*Do—for* 10 *miles.*

		£	£	£
1	Formation of Road ...		3,000	
	Rails, sleepers, &c., for 11¼ miles ...		11,099	
				14,099
2	Three locomotives ...			2,640
	Carriages.			
3	Two composites, six open cars, two vans, and 18 goods-trucks.			4,788
4	Sheds, &c. ...			1,250
5	Compensation, &c. ...			1,500
6	Fitting up offices ...			150
7	Tools, &c. ...			200
8	Sundry expenses ...			373
			Total £...	25,000

or
£ 2,500 per mile.

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III.—*Do—for* 15 *miles.*

		£	£	£
1	Formation of Road ...		4,500	
	Rails, sleepers, &c., for 18 miles.		18,162	
				22,662
2	Four locomotives ...			3,520
	Carriages.			
3	Two composites, 9 open cars, 3 closed vans, and 24 trucks ...			6,846
4	Sheds, &c. ...			1,750
5	Compensation, &c. ...			1,750
6	Fitting up offices ...			200
7	Tools, &c. ...			300
8	Sundry expenses ...			472
			Total	£ 37,500

or

£ 2,500 per mile.

N.B. No special form of sleeper is referred to, but it is believed that a suitable one can be obtained not weighing more than 70 tons per mile.

The prices of rolling stock have been taken higher than European prices on account of the increased width, and 40 per cent. has been added throughout for freight, insurance, &c., which it is considered is ample, the corresponding increase on Indian Railways not exceeding 25 per cent.

The rolling-stock allowed would be amply sufficient for the commencement of working. The same number of locomotives will be required for the 5 mile as for the 10 mile line. The prices of iron and steel are taken slightly in excess of current English prices.

A portion of the cost of laying is included in the £300 per mile estimate for the re-formation of the road.

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IV.—*Approximate cost of 5 miles of tramway, metre (3'. 3⅜") gauge.*

	Permanent Way.	£	£	£
1	Formation of Road.		1,500	
	Bessemer-steel rails, weighing 30 lbs. a yard...	330		
	Iron sleepers, 65 tons per mile.	195		
	Add 40 p/c for freight ...	210		
	Laying Permanent Way ...	176		
	per mile	911		
	for 6 miles		5,466	
				6,966
	Locomotives.			
2	Three at £500 each		1,500	
	Freight, &c...		600	
				2,100
	Carriages and Trucks.			
3	One composite car		200	
	Four open cars at £125 ...		500	
	Two closed vans at £100 ...		200	
	Twelve open trucks at £75 ...		900	
			1,800	
	Freight, &c...		720	
				2,520
4	Sheds, &c.			750
5	Compensation, &c.			1,000
6	Fitting up offices			100
7	Tools, &c.			100
8	Sundry expenses			464
			Total £...	14,000

or

£ 2,800 per mile.

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V.—*Do—for* 10 *miles.*

		£	£
1	Formation of road	3,000	
	Rail and sleepers (11½ miles)...	10,477	13,477
2	Three locomotives		2,100
3	Carriages as in II		3,780
4	Sheds, &c.		1,000
5	Compensation		1,500
6	Offices		150
7	Tools		200
8	Sundries		793
		Total £...	23,000

or
£ 2,300 per mile.

VI.—*Do—for* 15 *miles.*

1	Formation of road	4,500	
	Rails and sleepers, (18 miles)...	16,398	
			20,898
2	Four locomotives		2,800
3	Carriages as in III		5,075
4	Sheds, &c.		1,500
5	Compensation		1,750
6	Offices		200
7	Tools, &c.		300
8	Sundries		372
		Total £...	33,000

or
£ 2,200 per mile.

N.B.—The cost per mile is sensibly less than on the standard gauge. Continental prices have been taken for rolling-stock.

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The above tables give what is considered a fair estimate of the cost of construction of a line of steam-tramway, and I will now turn to the second of the propositions I have already laid down as requiring to be determined before a line can be undertaken, *i.e.*, the traffic returns. On English railways the gross expenditure and the net receipts are about equal; *i.e.*, taking a rough average, they are each about 50 per cent. of the gross receipts. On Indian railways however the figures for different lines show such enormous variation that any general average must be received with caution. For instance, for 1879 the following extremes are observable:—

Lines.	Proportion of expenditure to Gross Receipts.	Net Receipts.
Guaranteed Lines.		
East-Indian Main Line ...	31·85 p/c.	68·15 p/c.
Madras	68·68 „	31·32 „
Average for all Lines ...	48·16 „	51·84 „
State Railways.		
Sindia	134·96 p/c.	−34·96 p/c.
Muttra-Hathras	54·96 „	55·04 „
Average	78·82 „	21·18 „
General average	52·16 p/c.	47·84 p/c.

As regards tramway lines we have seen that on those round Milan the expenditure has been 80 per cent. of the receipts, (but a very much better average is expected), and in England, and on the continent generally, the expenses on horse tramways amount

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to from 90 to 75 per cent. of the receipts. There are no reliable figures from which a general average for steam-tramways can be obtained, but it is admitted that they will be much cheaper to work than the former, so that if I take from 70 to 75 per cent. as the proportion that the expenditure will bear to the gross receipts, I shall probably be on the safe side.

To attract capital to a line the probable net percentage on the outlay should not be less than 5 per cent. with a reasonable prospect of increase.

Taking now line No. I, which is the most unfavourable in the above tables, we find that 5 per cent. on the capital of £16,000 involves a net receipt of £800 per annum, which, as above stated, is probably about 25 per cent. of the gross receipts. These should therefore amount to £3,200 which gives £2,400 as the gross expenditure. The length of the line is 5 miles; so supposing 10 trains to run each way every day we get a daily mileage of 100 miles, and a yearly mileage of 36,500 miles. From these figures again we get 26·3*d.* as the gross receipts, and 19·37*d.* as the gross expenditure, per train-mile.

On Indian Railways in 1879 the corresponding figures are as follows, the extremes being given in each case as before.

Lines.	Gross Receipts per train-mile (goods and passenger.)	Gross Expenditure per train-mile.
Guaranteed Lines.		
Eastern Bengal	133· 68*d.*	
South Indian	66· 6*d.*	
Average	96· 96*d.*	46· 32*d.*

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Lines.	Gross Receipts per train-mile (goods and passengers.)	Gross Expenditure per train-mile.
*State Lines.**		
Punjab, northern	113·16*d.*	
Sindia	43·56*d.*	
Average	70·44*d.*	55·44*d.*
General average	92·64*d.*	48·44*d.*

On English railways, the receipts per train-mile average 69·3*d.* and the expenses 33·78*d.* On English horse-tramways, the receipts per mile run average 16*d.* and the expenses 12*d.* On the Italian tramway, the receipts per train-mile were 25·6*d.* and the expenses 20*d.* but it must be remembered that it carried next to no goods traffic, which in India would, it is expected, form a large portion of the receipts.

This expectation is based on the receipts of Indian railways where the goods traffic brings in about twice as much as the passenger traffic. The figures for 1879 are

	Passengers £	Goods £
All railways		
Gross receipts...	3,413,910	7,274,403

The receipts on the 5-mile line of tramway may be taken in a somewhat smaller proportion, and I will allow a higher ratio of passengers, say 14·3*d.* per train-mile from passengers and 12*d.* per train-mile

* Excluding coal-lines and Khamgaon Railway.

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from goods. On Indian railways the corresponding receipts average 72·36*d.* and 102·96*d.* The proportion of 3rd and 4th class passengers on Indian railways is 97·432 per cent. of the whole number carried, and it is stated also that 97 per cent. of the goods traffic belongs to the cheapest category. I will therefore, to be on the right side, take the whole of the above-mentioned tramway receipts at the lowest rates in each case. The lowest railway rates are ¼*d.* (2 pies), per mile for passenger, and 1*d.* (8 pies) per ton per mile for goods. Adopting these figures, we get an average of 57·2 passengers and 12 tons of goods per train-mile, which would be about a maximum train-load; or, assuming all the passengers and goods to go through from the town to the railway station, and *vice versa,* we have a yearly total of 337,562 passengers and 87,600 tons of goods, or a daily average of 1,144 of the former and of 240 of the latter, or 572 passengers and 120 tons of goods passing each way every day.

Would this high rate of traffic be obtainable? It would certainly seem doubtful to any one acquainted with the movement to and from Indian Mofussil towns, but with a smaller traffic the line could not be made to pay on account of its high capital cost. In fact, even with the returns quoted, the interest would soon fall into arrears, unless a development of traffic took place, and unless 150 or 200 train-miles a day could be run with full loads. The cost of running cannot be taken safely at less than 12*d.* a mile, though in Italy, with coke at almost its Indian price, the cost is only 7·9*d.* This would absorb £1,825 per annum leaving only £575 for depreciation, renewals, and sundries. As a matter of fact, at least £1,000 a year would be required for depreciation alone, which makes the deficiency very apparent.

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Taking on the other hand the 15-mile line, the capital of which is £37,500, the interest charges at 5 per cent. would be £1,875 making £6,250 the gross receipts, assuming on the larger concern that the expenditure is 70, and the profit 30 per cent. of the total. Supposing 6 trains to run each way every day we get a daily mileage of 180 and a yearly mileage of 65,700 miles, so that the gross receipts per train-mile are 22·83*d*. and the expenditure 15·981*d*. This would be provided by 10 tons of goods and 49·32 passengers per train-mile, in other words by 60 tons of goods and by 296 passenger passing each way every day.

The total yearly expenditure would be £4,375, and the running expenses, at 12*d*. a mile, £3,285, leaving £1,090 for renewals, &c. Or if the running expenses could be brought down to 10*d*. a mile, as they ought to be, we should have £2,738 to provide under this head, leaving £1,637 for other items. As a beginning, this would be fair enough, for it would only be rational to suppose that the traffic would largely develop, and that the country cart would be soon beaten in the competition for the carrying trade. If the town situated 15 miles from the railway, could double the assumed traffic in a year or two, all the figures given above would be also doubled, and the Company would obtain a 10 per cent. dividend, and be able to put by a very handsome surplus to form a sinking fund.

But it is time to bring this long chapter to a conclusion. The calculations for any of other line may be worked out in the same way, but enough has been said to show the relative advantages and feasibility of the undertakings. It will be seen that it would be difficult to make a short line a paying concern, unless there was an exceptionally heavy

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traffic, and any town so situated, that wished to possess the luxury of a tramway, would probably have to pay for it, by contributing a fixed yearly sum to the Company's receipts. A yearly contribution of £1,000 would probably enable the 5-mile tramway to pay its way, including renewals, &c., if the traffic were only as heavy as has been assumed.

For longer lines than those that have been taken, the cost of construction per mile might be a trifle less, and a proportionately smaller through traffic would leave a margin for profit.

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CHAPTER IV.

CONCLUSION.

It may be objected to the principle of reasoning adopted in the calculations of the last chapter that I have argued from results to premises, that I have first assumed the interest, deduced therefrom the net receipts, and thence the traffic. But in treating of the question generally no other alternative is possible, for it would not do to assume a traffic which might perhaps be higher than would be applicable to an actual case, and be therefore valueless. The method adopted too has this advantage, that it presents the question in the form the most adverse to the tramways. I have said that the receipts cannot be assumed less than a certain amount, and that the traffic must therefore amount to at least a certain total, if any line is to be thought of as a paying concern. It is within the compass of every one's powers to ascertain the total amount of passing traffic, and the only other requirement, before comparing it with the figures I have given, is to calculate the proportion of it that the tramway would attract. It is not an easy question and scarcely any data exist on which to frame an answer. But if the principal merchants of a busy town could be induced to become part proprietors in the Company, they would have a direct interest in sending their goods by its agency, and in promoting, by their example, the development of the passenger traffic. This, and fixing low rates, would furnish the best chances of

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success, and naturally no line would be undertaken except under reasonable prospect of support from those whom it was intended to serve.

The advantage of assuming the most adverse conditions is that, if the gross receipts may be taken higher than those obtained by the method of calculation adopted, so much the better for the chances of the tramway, but I would urge on every one who may be tempted to bring forward a scheme not to be over-sanguine. As has been already said, the distinguishing feature of enterprises in India is their timidity, and nothing encourages this timidity so much as failure in their beginnings. If the first lines are carefully chosen, cheaply constructed, and well worked, there is no reason why tramway enterprise should not develop, and result in the profitable employment of a good deal of capital, in a very rapid development of the internal trade of the country, and of a partial solution of one of the great Indian problems,—a successful famine campaign. But if blasted in its beginnings it will have a short life, and a poor one.

But, it may be urged by some into whose hands this pamphlet may fall, who is going to undertake these enterprises for which such a magnificent future is predicted? Even granting that we have, or that we can point to, a line which fulfils in some measure the stated conditions, we know of no expert to whom we can turn to seek for a reliable opinion on the prospects of our scheme. There is, at any rate in this part of India, no independent Engineering enterprise, and none but a very large concern could stand the cost of bringing out an Engineer specially from England to undertake the preliminary investigations.

The data necessary to be collected are not how-

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ever very elaborate, and the following list comprises every information that need be obtained before the actual proposals for the formation of a Company to construct a line are brought forward.

1. A map of the town, and of the country lying between it and the railway station, showing the road on which it is proposed to lay the tramway, other roads, and neighbouring villages.

2. The population of the town and villages.

3. A return of the traffic between the town and railway, and in the neighbourhood generally, detailing what it principally consists of, how carried, the approximate number of passengers and weight of goods, with rates of present conveyances.

4. A longitudinal section of the road, with cross sections at all important points, and a description of the bridges, culverts, &c. Also information as to the price and quality of the material of which the road is formed; distance of gravel and stone-quarries; prices of labour in the neighbourhood; depth and minute description of formation of road.

5. Cost of bringing machinery, or railway material to locality; cost of concrete work in ditto; and, generally, the cost of fuel and of such materials and labour as would be employed on a tramway. (These details for any neighbouring railway should specially be quoted.)

6. Particulars as regards the climate, rainfall, &c.

7. The conditions of the concession in detail;* noticing obligations as regards up-keep of road; liability to tolls, taxes, &c.; probability of guar-

* In Italy, tramway concessions are for a period of 50 years.

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antee; estimate of proportion of traffic tramway will secure, with reasons.

A combination of Local Fund and Municipal establishments would generally suffice for the preparation of all this information, and even if it did not, perhaps Government might, in the furtherance of the policy, announced in the Financial Statement (page 30) be induced to assist the Local authorities* by granting to them the services temporarily of one of their own officers.

* Though the steps taken by the Government with a view to offering facilities for the extension of railways where a proportion of the necessary capital have not been effectual, great advantages could be gained by interesting local communities and capitalists in making investments of local public utility, and we trust that the plan may be further considered, and, if possible, brought into practical operation. (Chapter V, Section 4, para. 11 of F. C. R.)

There is one point on which I would remark before I conclude, and that is as regards the management of the tramways. I have said that in all probability a moderate guarantee would be required, but there is this objection to a guarantee, that the irresponsible management of a small concern, (and it must be irresponsible in a great measure if the capital is not locally subscribed), is apt to be lax when there is an assured income.

But all tramways, and especially new tramways in a country new to them, require the best and most careful control, and I would therefore urge as a *sine quâ non* of management, either a stake in the Company, or a payment by results.

And here, I think, I may conclude. I do not pretend to have exhausted the subject, or even to have done more than to treat of it in the most elementary fashion. There are numbers of details,—such as the best form of road, of rail, of sleeper, of locomotive,

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of car, of truck, to adopt; the ticket system; the fares, and so on—which all have to be considered. But if the perusal of these pages carries with it the conviction that what has proved successful in Europe, may be as successful in, as it is undoubtedly suitable to, India, their purpose will have been fulfilled, and the above-mentioned details may safely be left for subsequent treatment.

I may add that, so far as the Madras Presidency is concerned, I shall be glad to answer any further questions on the subject that I am able, or to furnish any assistance that is in my power.

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